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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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09/456,873 12/08/99 MORI

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MMC2/0910

EXAMINER

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ART UNIT	PAPER NUMBER

2826

DATE MAILED: 09/10/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.

09/456,873

Applicant(s)

MORI, SEIICHI

Examiner

Leonardo Andújar

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 June 2001.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-18 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-18 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☒ Interview Summary (PTO-413) Paper No(s). 9.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

This office action is in response to the amendment B filed on 6/29/01, paper no.

Acknowledgment

1. The Amendment A filed on 6/27/2001, paper no. 7 and Amendment B filed on 6/27/2001, paper no. 8 in response to the Office action mailed on 3/28/2001 have been entered. The present Office action is made with all the suggested amendments being fully considered. Accordingly, pending in this Office action are claims 1-18.

Priority

2. Acknowledgment is made of applicant's claim for foreign priority under 35 U.S.C. 119(a)-(d). Acknowledgment is made of applicant's claim for foreign priority based on an application filed in Japan on 12/09/1998. The certified copy of the priority document has been received.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 5 and 9 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 5 and 9 recite the limitation "wherein silicon nitride layers formed by CVD method have a given trap density". It should be noted that these silicon nitride layers are not linked to any structural limitation of the claimed device. Moreover, claims 5 and 9 are rendered indefinite by making reference to a variable object, i.e., the recited limitation "lower trap density" is indefinite because the

relationship between trap densities is not based on any known standard for trap densities, but on a silicon nitride layer of unspecified trap density. *Ex parte Brummer*, 12 USPQ2d 1653 (Bd.Pat. App. & Inter. 1989).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 1, 2, 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takeuchi (5,661,056) in view of Klein et al. further in view of Yamada (JP 358106873A) further in view Wang et al.

7. Takeuchi discloses a non-volatile semiconductor memory device (figure 1) including a semiconductor substrate 11 and a memory cell having a floating gate 13 provided through a tunnel insulating layer 12 on the substrate 11. Takeuchi also discloses a control gate 15 provided through an inter-insulating layer 14 on the floating gate 13. The inter-insulating layer 14 includes a silicon oxide layer 14a contiguous to the floating gate 13, and silicon nitride insulating layer over the silicon oxide layer 14a (column 1, lines 37-60). However, Takeuchi does not disclose that the silicon nitride insulating layer includes a second silicon nitride layer with a trap density lower than a first silicon nitride layer. Also, Takeuchi does not disclose the hydrogen content. Klein et al. discloses a process to form good quality silicon nitride films by lowering the a

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hydrogen atomic content near 20% (4.7×10^{21} atoms/cm³). It is known in the art that the trap density is proportional to the hydrogen content; therefore by decreasing the hydrogen content the trap density of the layer is reduced. In the other hand, Yamada discloses a non-volatile memory device including a first silicon nitride film 104 which can be complemented by forming a second silicon nitride layer over a first silicon nitride layer 104, in order to obtain a desired thickness (abstract). However, Yamada does not disclose the hydrogen content of the second layer. Wang et al. discloses a process to form a silicon nitride film with a hydrogen atomic content of 12.5% (Table I). This type of layer can be used for pre-metal dielectric applications. Moreover, the silicon nitride layer shown by Wang et al. has a trap density lower than the one shown by Klein et al. It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the silicon nitride layer of Takeuchi with a hydrogen atomic content of 20% as taught by Klein in order to obtain a good quality silicon nitride films. Also, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form a second layer over the silicon nitride of Takeuchi in view of Klein et al. as taught by Yamada in order to obtain a desired thickness. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the silicon nitride layer of Takeuchi in view of Klein et al. further view of Yamada with lower hydrogen content by using the process taught by Wang et al. in order to make the layer useful for pre-metal dielectric processes.

8. Applicant's claim 2 does not distinguish over Takeuchi in view of Klein et al. further view of Yamada and further view of Wang et al. combination regardless of the

process used to form the second silicon nitride layer, because only the final product is relevant, not the process of making such as plasma-decomposition with silane-series gas and nitrogen gas mixture. Note that a "product by process" claim is directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See also *In re Brown*, 173 USPQ 685; *In re Luck*, 177 USPQ 523; *In re Fessmann*, 180 USPQ 324; *In re Avery*, 186 USPQ 161; *In re Wertheim*, 191 USPQ 90 (209 USPQ 554 does not deal with this issue); and *In re Marosi et al.*, 218 USPQ 289, all of which make it clear that it is the patentability of the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. Note that applicant has the burden of proof in such cases, as the above caselaw makes clear. See also MPEP 706.03(e).

9. Regarding claim 3, Takeuchi in view of Klein et al. further view of Yamada and further view of Wang et al. do not expressly disclose that the hydrogen content of the first silicon nitride layer is $10^{19}/\text{cm}^3$ or more. Although Takeuchi in view of Klein et al. further view of Yamada and further view of Wang et al. do not teach the exact hydrogen content of the second silicon nitride layer as claimed by Applicant, differences in concentrations are considered obvious design choices and are not patentable unless unobvious or unexpected results are obtained from these changes. It appears that these changes produce no functional differences and therefore would have been obvious. Note *In re Leshin*, 125 USPQ 416

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10. Regarding claim 4, Takeuchi in view of Klein et al. further view of Yamada and further view of Wang et al. do not expressly disclose that the hydrogen content of the second silicon nitride layer is $10^{19}/\text{cm}^3$ or more. Although Takeuchi in view of Klein et al. further view of Yamada and further view of Wang et al. do not teach the exact hydrogen content of the second silicon nitride layer as claimed by Applicant, differences in concentrations are considered obvious design choices and are not patentable unless unobvious or unexpected results are obtained from these changes. It appears that these changes produce no functional differences and therefore would have been obvious. Note *In re Leshin*, 125 USPQ 416.

11. Claims 7, 8 and 14-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takeuchi (5,661,056)

12. Takeuchi (figure 1) shows most aspects of the instant invention including a non-volatile semiconductor memory device comprising:

- a semiconductor substrate 11
- a memory cell having:
 - a. a floating gate 13 provided through a tunnel insulating layer 12 on the substrate 11
 - b. a control gate 15 provided through an inter-insulating layer 14 on the floating gate 13. The inter-insulating layer 14 includes a silicon oxide layer 14a contiguous to the floating gate 13 and a silicon nitride layer 14 located over the silicon oxide layer 14a (see column 1/lls. 37-48).

13. However, Takeuchi reference does not disclose that the hydrogen content is on the order of 10^{19}cm^3 or less. Although, Takeuchi does not teach exact the hydrogen concentration as that claimed by Applicant, differences in concentration or temperature will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such concentration or temperature is critical. "Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the workable ranges by routine experimentation". In re Aller, 220 F.2d 454,456,105 USPQ 233, 235 (CCPA 1955).

14. Applicant's claim 8 does not distinguish over Takeuchi regardless of the process used to form the silicon oxide layer, because only the final product is relevant, not the process of making such as plasma-decomposition with silane-series gas and nitrogen gas mixture. Note that a "product by process" claim is directed to the product per se, no matter how actually made, In re Hirao, 190 USPQ 15 at 17 (footnote 3). See also In re Brown, 173 USPQ 685; In re Luck, 177 USPQ 523; In re Fessmann, 180 USPQ 324; In re Avery, 186 USPQ 161; In re Wertheim, 191 USPQ 90 (209 USPQ 554 does not deal with this issue); and In re Marosi et al., 218 USPQ 289, all of which make it clear that it is the patentability of the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. Note that applicant has the burden of proof in such cases, as the above caselaw makes clear. See also MPEP 706.03(e).

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15. Regarding claim 14, Takeuchi (fig. 2a-b) shows most aspects of the instant invention including a non-volatile semiconductor memory device comprising:

- a semiconductor substrate 21;
- and a memory cell having:
 - c. a floating gate 23 provided through a tunnel insulating layer 22 on the substrate 21
 - d. a control gate 28 provided through an inter-insulating layer 27 on the floating gate 23. The inter-insulating layer 27 includes a silicon nitride layer 24 contiguous to the floating gate 23 and a silicon nitride layer 26 located over the silicon oxide layer 25 and contiguous to the control gate (col. 1/lis. 37-48).

16. However, Takeuchi reference does not disclose that the hydrogen content is on the order of 10^{19}cm^3 or less. Although, Takeuchi does not teach exact the hydrogen concentration as that claimed by Applicant, differences in concentration or temperature will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such concentration or temperature is critical. "Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the workable ranges by routine experimentation". In re Aller, 220 F.2d 454,456,105 USPQ 233, 235 (CCPA 1955).

17. Applicant's claim 15 does not distinguish over Takeuchi regardless of the process used to form the silicon nitride layer, because only the final product is relevant, not the process of making such as plasma-decomposition with silane-series gas and an

a gas containing nitrogen. Note that a "product by process" claim is directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See also *In re Brown*, 173 USPQ 685; *In re Luck*, 177 USPQ 523; *In re Fessmann*, 180 USPQ 324; *In re Avery*, 186 USPQ 161; *In re Wertheim*, 191 USPQ 90 (209 USPQ 554 does not deal with this issue); and *In re Marosi et al.*, 218 USPQ 289, all of which make it clear that it is the patentability of the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. Note that applicant has the burden of proof in such cases, as the above caselaw makes clear. See also MPEP 706.03(e).

18. Regarding claim 16, Takeuchi (fig. 2a-b) shows a second silicon nitride layer 26, wherein the first mentioned silicon nitride layer 24 and the second silicon nitride layer 26 are so double layered as to be contiguous to both of the floating gate and control gate, and still further including a silicon oxide layer 25 interposed between the double layer silicon nitride layers (col. 1/lls. 37-48).

19. Regarding claims 17 and 18, Takeuchi (fig. 9) shows that the interlayer 27 may include a second silicon nitride layer 76, wherein a first silicon nitride layer 72 and the second silicon nitride layer 76 are so double layered as to be contiguous to both of the floating gate and control gate, and still further including a stacked layer consisting of a silicon oxide layers (73, 75) and a silicon nitride 74 interposed between the double layer silicon nitride layers (col. 8/ll. 61 to col. 9/ll. 7).

Response to Arguments

20. Regarding applicant argument that Takeuchi, Klein, Yamada or Wang does not disclose an inter layer insulating layer comprising a silicon oxide, a first silicon nitride layer and a second silicon nitride layer, where the second silicon nitride layer formed by a JVD method, it is noted that one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Although, Takeuchi in view of Klein et al. further in view of Yamada and further in view of Wang do not disclose that the first nitrate layer is made by LPCVD method and the second nitride layer is made by JVD method, it is noted that those limitations are non claimed.

21. Regarding applicant argument that the features in accordance with the applicant invention are neither discloses or suggested by the cited references, it is noted that Takeuchi in view of Klein et al. further view of Yamada further in view of Wang discloses an inter-layer insulating layer comprising a silicon oxide, a first silicon nitride and a second silicon nitride, where the second silicon nitride exhibits a low trap density and/or a low hydrogen density (see paragraph 6).

22. Regarding applicant argument that ONO layer discloses by Takeuchi are not suitable for an inter layer insulating layer between a floating gate and the control gate, it is noted that Takeuchi discloses that the ONO layers have good withstand voltage characteristic even with a relative thin film thickness (col. 1/lls. 26-28).

23. Regarding applicant arguments related to the specific process to make the different layers of the inter-layer insulating layer, it is noted that a "product by process" claim is directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See also *In re Brown*, 173 USPQ 685; *In re Luck*, 177 USPQ 523; *In re Fessmann*, 180 USPQ 324; *In re Avery*, 186 USPQ 161; *In re Wertheim*, 191 USPQ 90 (209 USPQ 554 does not deal with this issue); and *In re Marosi et al.*, 218 USPQ 289, all of which make it clear that it is the patentability of the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. Note that applicant has the burden of proof in such cases, as the above caselaw makes clear. See also MPEP 706.03(e).

24. Regarding applicant argument that no one of the references discloses silicon nitride layer with a low hydrogen density and/or low trap density used as an inter layer insulating layer between a floating gate and a control gate, it is noted that one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Moreover, Takeuchi in view of Klein et al. further in view of Yamada and further in view of Wang disclose an inter-layer insulating layer comprising a silicon oxide, a first silicon nitride and a second silicon nitride, where the second silicon nitride exhibits a low trap density and/or a low hydrogen density (see paragraph 6).

Conclusion

25. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

26. A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

27. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Takeuchi (US 5,907,183) discloses non-volatile semiconductor device having a **NON** inter-insulator layer and other structures related to the instant invention. Papers related to this application may be submitted directly to Art Unit 2826 by facsimile transmission. Papers should be faxed to Art Unit 2826 via the Art Unit 2826 Fax Center located in Crystal Plaza 4, room 4C23. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2826 Fax Center number is **(703) 308-7722** or **-7724**. The Art Unit 2826 Fax Center is to be used only for papers related to Art Unit 2814 applications.

28. Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Leonardo Andujar** at **(703) 308-0080** and between the

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hours of 9:00 AM to 5:00 PM (Eastern Standard Time) Monday through Friday or by e-mail via Leonardo.Andujar@uspto.gov. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn, can be reached on (703) 308-6601.

29. Any inquiry of a general nature or relating to the status of this application should be directed to the **Group 2800 Receptionist** at (703)305-3900.

30. The following list is the Examiner's field of search for the present Office Action:

Field of Search	Date
U.S. Class / Subclass(es): 257/314-317, 324,325, 406, 410 and 411	08/01
Electronic Database(s): East (USPAT)	08/01

Leonardo Andujar

Patent Examiner Art Unit 2826

LA
9/9/01Nathan Flynn
Primary Examiner